Parameters: Phase I – Research and Planning – Shaylee Rademacher

1. The “Big” concept to be covered by this engineering design challenge is to learn to work through the engineering design process using an engineering notebook, by bundling content standards with engineering standards.

2. NGSS/MLS (Missouri Learning Standards)
    - Apply physics principles to design a solution that minimizes the force of an object during a collision and develop an evaluation of the solution.
    - Plan and conduct an investigation to provide evidence that the change in an object’s motion depends on the sum of the forces on the object and the mass of the object.
    - Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
    - Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

3. Problem Solving
    - Students will work together to agree on the best solution to the problem. This isn’t always easy for middle schoolers, and is always a learning opportunity. Students almost always think their idea is the best. Learning that other people have valid, and sometimes better, ideas is a valuable life skill.
    - Students will have to create a space lander that meets the constraints of size, limited supplies, time, etc. Again, many middle schoolers want to drag their feet, mess around, and then hurry up and throw something together when the time limit draws near. Requiring a plan with a sketch that has to be approved prior to the “create” step will help students solve this problem. They always want to get right to the build.
    - Students will observe the drop of their lander, and can record it using slow-motion cameras on their phones. They can use the video to evaluate what happened to the design upon impact of the lander with the ground. This will help students to see where the structure is failing (astronauts/large marshmallows bouncing out of the Dixie cup) and decide how to fix the problem through the iterative nature of the design process.

   Declarative knowledge
    - Students will need to know that gravity pulls objects toward the center of the Earth (down, never up).
    - Students will need to know that all things made of matter, have mass, and are affected by the force of gravity (Law of Universal Gravitation).
    - Students will need to know that air exerts an upward force on objects that reduce the acceleration due to gravity.
    - Students will need to understand that objects that are falling experience acceleration due to gravity.
    - Students will need to know that acceleration can mean to speed up, slow down, or change directions.

Procedural Knowledge

- Students will need to know how to listen respectfully to everyone's ideas.
- Students will need to know what information should be recorded in the engineering notebook.
- Students will need to know the criteria/requirements/constraints for the project.
- Students will need to know that they cannot start the building/creating phase until they have an approved plan.
- Students will need to know how to work at a volume that is conducive to a productive classroom.
- Students will need to know how to "fail forward," that failure is expected, and that their first idea may not work, and is usually the most common.

4. The ELA Missouri Learning Standards that will be addressed with this activity are:
    - Follow rules for collegial discussions and decision making, track progress toward specific goals and deadlines, and define individual roles as needed.
    - Delineate a speaker's argument and claims, evaluating reasoning in order to pose questions that elicit elaboration and respond to others' questions and comments with relevant observations and ideas that bring the discussion back on topic as needed.
    - Speak clearly, audibly, and to the point, using conventions of language as appropriate to task, purpose, and audience when presenting including appropriate volume at an understandable pace.
    - Position body to face the audience when speaking, and make eye contact with listeners at various intervals using effective gestures to communicate a clear viewpoint.
    - Plan and deliver appropriate presentations based on the task, audience, and purpose including multimedia components in presentations to clarify claims and findings and emphasize significant points.

5. The NASA Space Lander challenge is the activity I would like to do for this project.

6. I think the best activity to use to teach the given objectives is the NASA Space Lander challenge. When I was out of my classroom for a district meeting I had my students watch the NASA documentary called "The Mars Generation." This video shows students 8th grade (just one year older than my students) through high school involved in a week-long space camp. They show the students going through the design process, and even talk about the need for research and design for landers on Mars. This is the perfect intro to this activity. I have done it for two years now, and the students love it. I'm using it again this year, but will introduce the more formal engineering design process along with the engineering notebook/journal.